

Douglas A. Ducey
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY



Misael Cabrera
Director

via e-mail

February 11, 2016
FPU16-168

Ms. Catherine Jerrard
AFCEC/CIBW
706 Hangar Road
Rome, NY 13441

RE: WAFB – ADEQ Comments – ST012 - *Discussion toward extending Steam Enhanced Extraction (SEE), Enhanced Bioremediation (EBR) transition, Site ST012, Former Williams Air Force Base, Mesa, Arizona*

Dear Ms. Jerrard:

Arizona Department of Environmental Quality (ADEQ) Federal Projects Unit (FPU) and ADEQ contractors UXO Pro, Inc. and Praxis Environmental discussed proposed Steam Enhanced Extraction (SEE) process shutdown as a step toward Enhanced Bioremediation (EBR) transition. ADEQ discussion was guided by U.S. EPA knowledge and input. This letter presents a general ADEQ statement, followed by ADEQ's EBR transition criteria comments. ADEQ requests that the following items be considered.

General Statement

ADEQ's position has not changed from that stated in the General Comment provided in the letter of November 19, 2015 (FPU16-109) to the Air Force, and is restated herein:

"The criteria for transitioning from SEE to EBR are provided in Table 4-2 of the May 2014 Work Plan. Two primary criteria are diminishing mass extraction rates (less than 10% of peak rates during SEE) and benzene groundwater concentrations less than 500 µg/L. To date, neither of these criteria have been demonstrated nor have indications of achieving these criteria in the near future. Mass removal rates are discussed in the Specific Comments [FPU16-109] and insufficient data have been provided regarding benzene concentrations. Until further progress is demonstrated, discussion of transitioning to EBR is premature."

Specific EBR Transition Criteria

Subsurface Temperature

Temperatures are no longer a topic of discussion for ADEQ regarding transition to EBR. Subsurface temperature is an indirect remediation measure and has been extensively discussed.

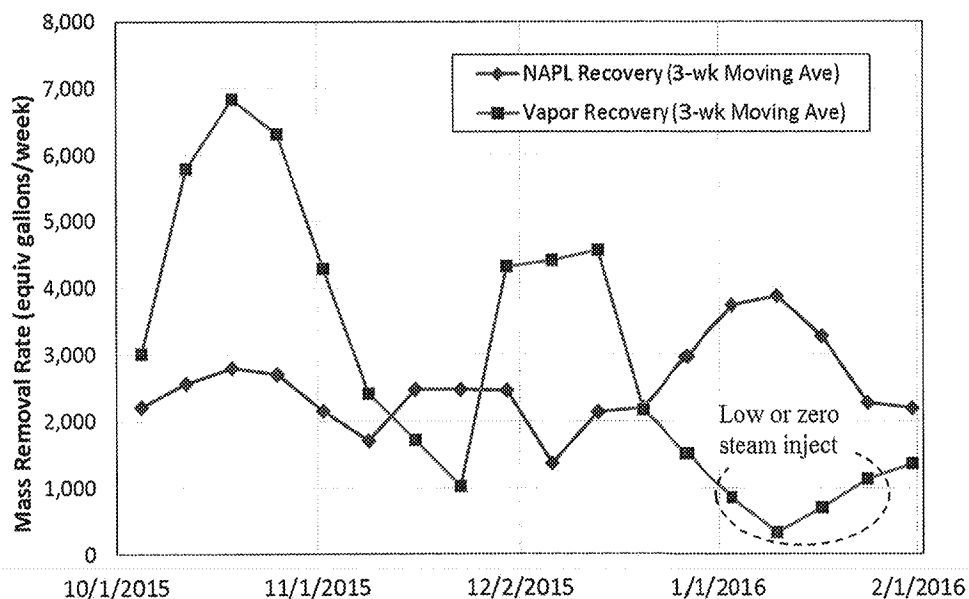
Completion of Pressure Cycling

ADEQ does not consider pressure cycling a viable metric for transitioning to EBR. Pressure cycling has not improved mass removal of volatiles at ST012 during SEE based on the data presented (e.g., Slide 21 of the January 2016 Base Closure Team (BCT) ST012 presentation). While pressure cycling to improve the recovery of volatile contaminants dissolved in water has been demonstrated at other sites and has a firm scientific basis, the same cannot be said for volatile compounds dissolved in a multicomponent Non-Aqueous Phase Liquid (NAPL) dominated by heavier hydrocarbons. The lack of improved mass recovery in the vapor phase during pressure cycling suggests benzene mass remaining in the Thermal Treatment Zone (TTZ) is primarily dissolved in residual NAPL rather than dissolved in water. Benzene dissolved in residual NAPL is not treatable by EBR until it is dissolved into surrounding water.

Mass Removal

ADEQ asserts the mass removal criteria for transition to EBR has not been achieved.

Data from weekly progress reports were plotted to show the average gallons of NAPL recovered each week starting in October 2015. Equivalent gallons of NAPL recovered in the vapor phase were also plotted and the results are illustrated below. The NAPL recovery rate (red) has not decayed over the last four months, consistently averages over 2,000 gallons per week, and no indication of decay is evident. The vapor recovery rate (blue) illustrates a general decay; however, the rate dropped when the steam injection was lowered and ceased at the beginning of January. This drop in vapor recovery with steam cessation indicates significant mass continues to be recovered from within the TTZ by steam injection and that mass recovery rates continue to be related to steam injection.



As stated in the Work Plan, the actual site specific removal rate curve will be evaluated to confirm or adjust the appropriateness of 10% of maximum to represent a condition of diminishing returns. The plan further states, continued operation below the 10 percent of peak removal rate may be implemented depending on the significance of continued mass removal, the status of Contaminant of Concern (COC) concentrations (e.g.,

benzene) in extracted fluids, and the need/ability for EBR to achieve further degradation based on data collected during the EBR field test. The Air Force has not presented any assessment of the appropriateness of the 10% value for diminishing returns and in particular a value comparison of mass removal rates during SEE with those anticipated for EBR. For example, a total hydrocarbon rate of 1,400 pounds per day entering the thermal accelerator for destruction can be viewed as the equivalent of injecting 1.5 tons of sodium sulfate per day under perfect conditions. This calculation assumes complete sulfate utilization and only 30% of the extracted hydrocarbon mass would be available in the subsurface (assumptions in EBR Work Plan Addendum). A NAPL recovery rate of 300 gallons per day is equivalent to the injection and utilization of 2 tons of sodium sulfate per day under the assumptions of the Work Plan Addendum and assuming the NAPL components dissolve into water that then mixes with the sulfate solution to yield complete utilization by contaminants.

It is the opinion that mass removal should not be divided, or a distinction made, between mass within the treatment zone and mass outside the treatment zone. The process should continue as long as mass is removed. The Record of Decision (ROD) does not distinguish between the within/without TTZ boundary.

It is the opinion that SEE should continue until the NAPL outside the TTZ is removed. It is the opinion that expanding the steam system is viable.

It is the opinion that it is not demonstrated that the sulfate injection can degrade LNAPL to meet remedial action objectives (RAOs) by 2032.

It is the opinion that EBR has not been demonstrated to be appropriate to treat NAPL, only dissolved phase. The ROD does not state that EBR will be employed to treat NAPL.

Benzene Concentrations

ADEQ asserts the benzene concentration criteria for transition to EBR has not been achieved

As stated in the Work Plan, benzene concentrations in extracted groundwater are monitored for transition to EBR against a target benzene concentration in the 100 to 500 microgram per liter ($\mu\text{g/L}$) range within the TTZ. The most reliable measure of benzene concentrations in extracted groundwater is provided at the air stripper inlet. These concentrations are decaying (Slide 29 of the January BCT ST012 presentation) but remain well above 500 $\mu\text{g/L}$ and well above the value measured when steam injection was initiated. At a minimum, this measure of benzene concentration should fall below its initial value to indicate a significant overall depletion of benzene from the TTZ even if the benzene from the perimeter is contributing to the extraction. Such decay has not been achieved indicating heat from steam injection continues to enhance benzene extraction.

Benzene located around the perimeter of the TTZ and the perimeter/interior extraction wells contribute to the benzene in the extracted groundwater. If the interior is “clean” compared to the perimeter, the mass removal rate should increase with the cessation of steam injection as extraction from the perimeter increases. However, as described above, the opposite was observed indicating significant mass remains in the TTZ.

Calculated benzene concentrations in individual extraction wells were presented in Slides 32-34 of the January BCT ST012 presentation. These values are not measured directly but are calculated with significant uncertainties using a mass balance. In addition, these measures were performed when approximately half of the extracted water originated through clean water injection (i.e., steam injection) potentially diluting the

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extracted water. Pathways of water flow during SEE are not representative of ambient groundwater flow or resulting benzene concentrations post-SEE.

Steam Injection

ADEQ asserts that reaching the steam injection quantity guideline is not a basis for transitioning to EBR.

As stated in the Work Plan, the actual steam required to achieve the other criteria may be more or less than originally estimated. Because this parameter does not directly measure remediation performance its primary use is to assess the estimate in the design. As a result, ADEQ does not consider attaining the design steam injection target criteria of 319,357,000 pounds to be a metric for transitioning to EBR.

Closure

ADEQ may add or amend comments if evidence to the contrary of our understanding is discovered; if received information is determined to be inaccurate; if any condition was unknown to ADEQ at the time this document was signed; or if complementary regulatory agencies bring valid and proven concerns to our attention.

Thank you for the opportunity to comment. Should you have any questions regarding this correspondence, please contact me by phone at (602) 771-4121 or e-mail miller.wayne@azdeq.gov.

Sincerely,



Wayne Miller

ADEQ Project Manager, Federal Projects Unit

Remedial Projects Section, Waste Programs Division

cc: Catherine Jerrard, USAF AFCEC/CIBW
Carolyn d'Almeida, U.S. EPA
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ADEQ Reading and Project File

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